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# SOVIET ELECTRON MICROSCOPES AND THEIR APPLICATION IN RESEARCH

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/Comment: Soviet electron microscopes and their research applications are described briefly in this report. While most of the information is probably not new, it is felt that its inclusion in a single report may be of some value. Photographs of all microscopes described in the report are available in the original document in the Library of Congress, with the exception of the type described in the section on emission microscopes./

## Magnetic Electron Microscopes

The 50-kv electron microscope designed by Academician A. A. Lebedev, Stalin Prize Winner, V. N. Vertsner, Candidate in Physicomathematical Sciences, and N. G. Zandin, Engineer-Designer, has a resolving power of about 50 angstroms and gives magnifications of from 2,600 to 22,000 times. A 100-kv magnetic electron microscope was designed by Lebedev, N. G. Sushkin, and A. G. Plakhov, Candidates in Technical Sciences, Yu. M. Kushnir, Candidate in Physicomathematical Sciences, and P. V. Zaytsev, Engineer-Designer. This microscope has been called a universal microscope, since objects can be studied either by transmission or reflection. In addition, objects which emit electrons when heated can be studied by means of this microscope. The feature of this microscope is the possibility of obtaining magnifications from optical (200 times) to greater than optical (25,000 times) without disturbing the vacuum in the column, as in other magnetic electron microscope designs. A 50-kv desk-type electron microscope was developed under the supervision of Academician Lebedev by Sushkin and engineers Zaytsev and O. N. Rybakov. The microscope will give magnifications of 1,000-15,000 times with proper selection of the projection pole pieces. A feature of this microscope is that the objective and projection lenses are made in one unit which the pole pieces are connected by a common rod. The resolving power of the microscope is 100 angstroms.



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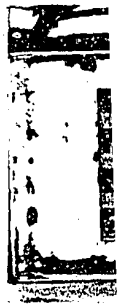

Electrostatic Electron Microscopes

A 50-kv electrostatic electron microscope developed under the supervision of Academician Lebedev by V. I. Milyutin, Candidate in Physicomathematical Sciences, and engineers D. V. Fetisov and K. K. Raspletin, has a resolving power of 80-100 angstroms. The electron-optical magnification of the microscope can be varied from 1,000 to 6,000 times; its useful magnification is 20,000-25,000 times.

Emission Microscopes

In emission microscopes, the object to be studied is also the electron source. After being accelerated and refracted in the electric field of the first lens (immersion type), the electron beam passes through a system of magnetic or electrostatic lenses and produces an image of electron source on a fluorescent screen or photographic plate. Emission microscopes are divided into four types, thermionic, photoelectronic, secondary, and field (cold) emission, depending on the method used to liberate electrons from the cathode. There are many types of operation for which the emission microscope is well suited but their resolving power is ordinarily one order less than that of good optical microscopes. Recently, Prof G. V. Spivak and engineers A. M. Rozenfel'd and Zaytsev designed and built an emission microscope with a resolving power (500 angstroms) greater than that of optical microscopes.

Power Supplies

There are two basic methods of designing power supplies for magnetic microscopes. The first makes use of a rectified and regulated power-frequency current for obtaining the high voltage, with the lenses supplied either from a high-capacity bank of storage batteries or from the unit where the power-frequency current is rectified and regulated. The second method involves the use of a rectified rf current obtained with special radio circuits to supply the stabilized high voltage. In the latter case, the lenses are supplied by a rectified and regulated power-frequency current. The first method is ordinarily used in Soviet-designed electron microscopes. Power-supply units for all Soviet magnetic electron microscopes were developed by engineers G. F. Zakharov, V. V. Polivanov, and Yu. V. Zolotarenko, and for all electrostatic electron microscopes by engineer K. K. Raspletin.

Research Applications

Many different biological studies are being conducted in the USSR with the help of the electron microscope. The Laboratory of Electron Microscopy, Department of Biological Sciences, Academy of Sciences USSR, is studying practical problems of microbiology, virusology, and biochemistry by using the large magnifications of the electron microscope. Interesting results have already been obtained regarding the action of antibiotics and bacteriophage on bacterial cells and structural features of vegetable cells have been clarified. Important work on the electron microscope study of the effect of various agents on the tuberculosis bacillus is being done in the Ural Affiliate of the Academy of Sciences at Sverdlovsk. Future studies of animal and vegetable viruses and noncellular forms of living matter have been planned in the Academy of Sciences USSR and the Academy of Medical Sciences USSR on the basis of new data obtained by Stalin Prize Winner O. B. Lepeshinskaya. Work has been published recently on the application of the electron microscope method in histology to make possible the study of the structural features of the hide component collagen are being studied in institutes of Leningrad and Moscow.



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Work on the application of the electron microscope in chemistry is conducted in many institutes of the Academy of Sciences and other scientific research institutes. Of special note are the successful electron microscope studies of catalysts made in the Institute of Physical Chemistry, Academy of Sciences USSR, under the direction of Corresponding Member S. Z. Rgoinskiy, studies of the structure of activated carbon and mineral adsorbents, studies of carbon black and rubber, and many others.

In physics, the electron microscope has been used in the USSR for the study of processes occurring at electrodes in a gas discharge, for the study of electric erosion, for electronic-ionic microscopy in gases, for the investigation of the interaction of electrons with matter and the action of electrons on photoemulsions, and, finally, for the study of photocathodes.

The electron microscope is used in geology for the study of coal, clays, and various fertilizers (phosphates).

The electron microscope has been used extensively in the USSR for the study of metals. Of note in this field are the studies of the Ural Affiliate of the Academy of Sciences on the initial stages of decomposition in aluminum alloys, on the mechanism of plastic deformation of aluminum crystals, and on the structure of steels obtained in annealing and in isothermal decomposition.

Interesting work has been conducted jointly by the Ural Polytechnical Institute and the Ural Affiliate of the Academy of Sciences on the study of the smoke sublimates of steel-smelting furnaces. The Institute of Steel imeni I. V. Stalin has done interesting work on the study of magnetic steels.

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